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APPLICATION NUMBER: *60/529,832*
FILING DATE: *December 16, 2003*
RELATED PCT APPLICATION NUMBER: *PCT/US04/42114*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US60/529,832*

Certified by

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Voytek	Wilczak	109-41 East Shearwater Court, Jersey City, NJ 07305

☐ *Additional inventors are being named on th____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

Grafting Acrylate Groups to Organic Substrates Using Plasma Atmospheric Pressure Glow Discharge (APDG)

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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Type Customer Number here

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☒ Firm or Individual Name	Sun Chemical Corporation				
Address	222 Bridge Plaza South				
Address					
City	Fort Lee	State	NJ	ZIP	07024
Country	USA	Telephone	201-224-4600	Fax	201-224-2439

ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 3 ☐ CD(s), Number

☐ Drawing(s) *Number of Sheets* ☐ Other (specify)

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

		FILING FEE AMOUNT ($)
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE Sidney Persley

TYPED or PRINTED NAME Sidney Persley

TELEPHONE 201-224-4600 Ext. 278

Date 12/16/03

REGISTRATION NO. *(if appropriate)* 34,898

Docket Number: C-605

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10) Applicant(s): Voytek Wilczak	Docket No. C-605

Serial No.	Filing Date	Examiner	Group Art Unit

Invention:

Grafting Acrylate Groups to Organic Substrates Using Plasma Atmospheric Pressure Glow Discharge (APDG)

I hereby certify that this **Provisional Patent Application**
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INVENTION RECORD

Sun Ch mical Corporation

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NOV 21 2003
SIDNEY TECHNOLOGY

Inventor(s)	Case #	Origin
Voytek Wilczak	C-605	

Descriptive Title
Grafting Acrylate Groups to Organic Substrates using Plasma Atmospheric Pressure Glow Discharge (APDG)

Status f Invention

C nception Date
Oct 27, 2003

Applying atomized monofunctional acrylates into the plasma field anc depositing them onto moving webs as thin coatings is not new However, the goal to date was to crosslink all acrylate groups and thus obtain a crosslinked acrylic thin film for such properties as adhesior promotion, water repellency, or water acceptance. The idea is nove because I am proposing to use multi-functional acrylates and ON PURPOSE leave some acrylate groups UNCROSSLINKED in the deposited film, leaving them available for reaction with EC coatings anc inks (not adhesives – see prior art below).

1st Written Description Date:	Where Recorded:	Date Prepared:	Date Received:	Rating:
Oct 28, 2003	Sun E-mail (attached)	11/18/03	11-21-03	

BACKGROUND OF INVENTION:

This invention involves using Atmospheric Pressure Glow Discharge (APDG) to attach unpolymerized acrylate groups to organic substrates, such as moving plastic webs. The technique involves introducing a liquid precursor (a multi-functional acrylate) directly into APDG via an ultrasonic nebulizer, and depositing the precursor onto the substrate under such conditions that some acrylate groups remain unpolymerized while some polymerize and get attached to the substrate. The un-polymerized acrylate groups can then be available to react with Energy-Curable inks, coatings, or adhesives, greatly improving adhesion.

PRIOR ART:

WO 00/78469 deals with epoxy based coatings (specifically gycidyl methacrylates and the like) that are plasma deposited and pulse plasma polymerized to form a coating film. They can be further derivatized by using acids, amines, etc. Their use as an adhesive (laminating?) is also detailed. The polymerization usually occurs with the deposition, but there are reactive groups (epoxies) that are left unreacted.

Our biggest obstacle will be Claim 13 which reads: A method for adhering two surfaces together, said method comprising applying a reactive coating to at least one of said surfaces by plasma deposition, and contacting said surface with the other surface under conditions whereby reactive groups in the coating will react so as to secure the two surfaces together.

Since they simply state under conditions without giving details, use of EB to achieve the crosslinking will fall under this claim if we use epoxy based monomers, or possibly any reactive species since in this particular claim they do not distinguish what reactive coating the are using. However, in all of the other claims and spec they are using epoxy based monomers. **This may preclude our use of this for laminating applications**.

WO 02/28548 is a Dow Corning patent that covers the use of the technology of using plasma to coat a substrate.

The broad Claim 1 reads: A method for forming a coating on a substrate, which method comprises introducing an atomized and/or solid coating forming material into an atmospheric pressure plasma discharge and/or ionizing gas stream resulting there from, and exposing the substrate to the atomized coating-forming material.

This claim would seem to cover using plasma discharge to coat a substrate with reactive materials. They do mention both epoxies and mono-acrylates. The also mention the polymerization is carried out using atmospheric pressure plasma discharge (i.e. it is polymerized when deposited).

Polymerization is essentially complete with deposition. There is no intention of having a second polymerization reaction, other than to post treat with a second plasma discharge (claim 15).

As long as we are using a plasma to coat a substrate with reactive species, we are in danger of infringing on claim 1 above. We could license the technology, or try to differentiate our method from theirs. In our method, we would prefer to leave as much unreacted by the plasma as possible, since we will finish the reaction with EB. In their method, they essentially want complete polymerization.

We could probably use the method to pre-coat a film with an adhesion promoter and print over it.

Maybe a claim like: A method of producing a cured coating or ink on a substrate comprising:

A) coating a substrate with coating forming (adhesion promoting) ethylenically unsaturated material using a plasma discharge and/or ionized gas stream such that the coating forming material is only partially polymerized and retains ethylenically unsaturated moieties at the end of the plasma treatment
B) adding a second or more layer of an energy-curable coating material (or ink) using conventional means
C) curing (or polymerizing) the coating with actinic radiation to produce a dry film.

The key to our using this technology is that we do not want to polymerize all the species in the plasma deposition. We want to cure with EB at a later stage. We could also use low energy plasma to deposit and not totally polymerize the coating. At the very least, we are offering an improvement on their method as plasma polymerization usually produces very highly crosslinked polymers that lack a regular repeat unit. We would produce polymers with a much more consistent structure and different final properties.

In summary, Dow has a fairly strong position using this technology. We could probably use the technology as a means of applying an adhesion promoting agent, and we may be able to use the technology if we are able to show that we polymerize the reactive species to a lesser degree with the intention of curing it later with a second type of energy.

Other relevant patents are:6,548,121 (grafting of photoinitiators to film surface), 6,551,950 (grafting of halo-organic compounds to surfaces using plasma), US Patent Application 20020114954 (bonding fluoropolymer films to substrate), US Patent Application 20030104140 (depositing organosilicons onto substrates).

SUMMARY OF INVENTION:

Instant invention describes a process of atomizing a liquid, multifunctional acrylate monomer (such as TMPTA) and injecting it directly into Atmospheric Pressure Glow Discharge (APDG). APDG is described, for example, in WO 02/28548, assigned to Dow Corning. But in the prior art the desired outcome of injecting monofunctional acrylates into APDG, often bearing other functional groups such as fluoro, epoxy, etc, was to fully polymerize the acrylate groups, thus anchoring the functional polymer to the substrate. Such polymer would then serve as an adhesion promoter or water repellant. In the instant invention, the APDG conditions are selected in such a manner that some acrylate groups of the multi-functional acrylate are crosslinked in the plasma, but some remain un-polymerized, serving as excellent covalent anchors to Energy-Curable inks and coatings.

ADVANTAGES OVER PRIOR ART:

Prior art sought to polymerize all acrylate groups, thus making creation of covalent acrylate-acrylate bonds between the substrate and ink or coating impossible. The instant invention allows for formation of such bonds instantaneously when the ink or the coating is energy-cured.

DESCRIPTION OF INVENTION:

Main Claims (example):

A method of producing a cured coating or ink on a substrate comprising:

A) coating a substrate with coating forming (adhesion promoting) ethylenically unsaturated material using a plasma discharge and/or ionized gas stream such that the coating forming material is only partially polymerized and retains ethylenically unsaturated moieties when deposited on the substrate
B) adding a second or more layer of an energy-curable coating material (or ink) using non-plasma means
C) curing (or polymerizing) the coating (or ink) with actinic radiation to produce a dry film.